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ABSTRACT

Research on the cognitive processes involved in teaching is reported. Experienced teachers were observed and interviewed in an effort to determine the following: 1) how the teacher perceives the class and individual students: 2) how the teacher interprets information gathered through perception: 3) how the teacher uses information acquired through experience in class situations: 4) how teacher expectations influence their classroom behavior: 5) what influences a teacher's decisions concerning lesson structure: and 6) what influence does the teacher's self concept and personal reaction to classroom environment have on his or her behavior while teaching. Implications for teacher education are discussed. (JD)

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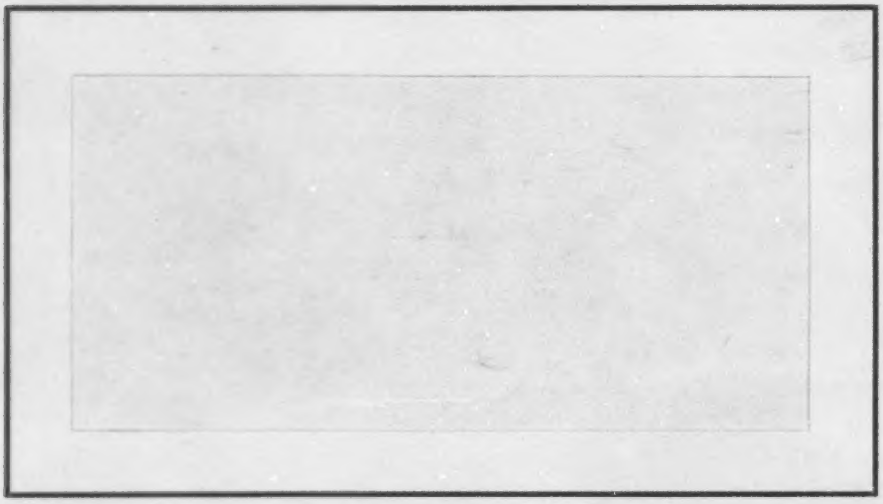

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Report no. 21

A PROCESS ANALYSIS OF TEACHING *

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Katholieke Universiteit Leuven
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* A summary of the doctoral dissertation, THE PROCESS ANALYSIS OF TEACHING, by J. Lowyck as supervised by Professor Dr. E. De Corte : a study of the cognitive variables in the pre-interactive and interactive behavior of experienced teachers - a review of the literature and descriptive, empirical research. (Unpublished doctoral dissertation, Louvain, Belgium, 1978, XII-247 pp.)

A PROCESS ANALYSIS OF TEACHING *

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Introduction

This study was originally intended as a contribution to the systematizing of the skill training for student teachers. In addition, under the influence of the increasing interest in microteaching in Belgium at the early 1970's, research in this direction was planned.
Attention should be devoted primarily to the effects of this method on the real classroom teaching of teacher-trainees.

Concrete experiences with microteaching (Lowyck, 1972) as well as an extensive study of the literature dealing with it has brought a number of moteworthy points to light. Microteaching consists of the systematic training of a determined number of analytical and discrete technical skills in a reduced context - that is, component skills. Such an analytical and simplified framework, however, bypasses the complexity of teaching itself. Moreover, one tends to concentrate only on outwardly verifiable and quantifiable behavior; there is no attention given to the processes which can be seen to underlie it. Finally the choice of the distinguishable skills is taken in a merely pragmatic way, with the result that every theoretical basis for the selection of critical teaching skills is lacking.

Microteaching, therefore, has been seen as an excessively restricted basis for the study of skill training in which the complexity of teaching can be dealt with adequately. A combination of training methods which are available was deemed advantageous in confronting this problem. A fan of mutually complementary forms of training should do justice to the complexity of teaching. On the basis of anticipating just this, the following training methods have been explored : observation in real classrooms, interaction analysis, the case method, role play, simulation, and self-confrontation. As mentioned, microteaching was studied already in the previous phase of this work. Fleeting consideration of the methods herein named permits the assertion that, in fact, their significantly complementary value could be affirmed. Therefore, not only the external behavior of the teacher but also a number of aspects of this internal functioning such as decision-making and problem-solving were taken into account.

A project for experimental research was developed on the basis of this broader concept. The main purpose of the project was to investigate whether and to what degree specific components from the training methods were effective on certain types of teaching skills. The search for a possible differential effect led to the further operationalizing of the project. There was, on the one hand, the

need to identify a number of training components while, on the other hand, various types of teaching skills had to be identified.
Collecting a number of important training components presented few difficulties : there was sufficient literature on hand to trace down the constituent elements. In this way, five training components were determined : information, observation (discrimination learning), exercise, feedback, and repetition. The painstaking operationalizing of what was understood to be among "types" of skills resulted, however, in a considerable number of problems. On the basis of the existing literature, it seems impossible to obtain certainty in relation to the essence and functioning of teaching skills. This determination dictated an important decision :

1. Whether the experimental project should be further pursued while suffering from the partial neglect of the valid operationalizing of types of teaching skills; or
2. Whether the problematic nature of teaching skills should be considered central, whereby the research problem could be transliterated from the methods of training to the object of training itself, namely teaching and teaching skills .

The second alternative was finally adopted. Deeper insight into the nature and progress of teaching and teaching skills was deemed indispensable for the fundamental study of the training of teaching skills.

Following along the lines of the above mentioned insights, it was decided to undertake a descriptive-empirical investigation into the cognitive variables of teaching. This places one in a position to determine what processes are important during the pre-interactive and interactive phase of teaching.
To secure the foundation of and provide the direction to this empirical research, a comprehensive study of existing literature until 1978 was instituted. Because the Anglo-Saxon literature occupies a key position, the study was restricted to this area, while, nonetheless, the extension into other areas appears desirable.

1. The data from the literature

As to content, three topics were investigated : the description of teaching and of teaching skills, the (cognitive) models of teaching and skilled behavior, and the research on teaching and on teaching skills. The most important results are reiterated below.

1.1. The description of teaching and teaching skills

Because the literature on teaching and teaching skills encompasses such an enormous number of studies, the analysis has been restricted to the precise definitions which a number of authors make explicit in their publications. Although not all the possible properties of teaching and teaching skills will be brought to light, it may be reasonably expected that at least the essential characteristics in the definitions have been reported. Precisely delineated definitions of teaching are present in the empirically oriented literature as well as in that of the analytic philosophy. The most important data are provided in what follows. For a more comprehensive report, an additional study (Lowyck 1979a) may be recommendable.

In the empirically oriented literature, there are two main tendencies which are preponderant. According to some (Lumsdaine, 1963; Corey, 1967; Skinner, 1968; et al.), teaching c.q. instruction ensuing from the systematic influencing of pupils, exists for the attainment of specified and operationalized results. To that end, the environment must be controlled and manipulated as well as possible so that efficiency in learning is assured. Teaching receives, hereby, a rigidly guided character, and the pattern of the interaction is largely unilateral. The instruction can as well proceed upon the absence of the teacher. Others, such as Amidon and Hunter (1969), Flanders (1970), and Strasser (1971) see teaching as an interactional occurence. It is not so stringently directed toward the handling of situational variables in order to achieve specified results. The primary accent lies, in fact, on the direct contact between teacher and pupil, wherein the quality of this interpersonal relation is the central issue. Teaching is, then, a specific type of social behavior, and this forms the basis on which learning becomes a reality.

The conceptual-formal analysis of the philosophy of language strives toward the clarification of the phenomenon through reaching and systematizing the semantic meaning of the concepts. At the same time, it implies the construction of the conceptual expansion to a certain picture of man as a rational and purposeful being. One comes, then, to regard teaching as a rational and purposeful activity of the teacher which is directed to the intelligent, critical, and reflexive treatment of the pupil. These qualities form the criteria on the basis of which a certain type of behavior may be specified as teaching.
(Scheffler, 1968; Komisar & Nelson, 1969; Hirst, 1971; et al.)
The above mentioned concepts and approaches are not opposed here but rather regarded as complementary so that the following definition of teaching can be proposed : teaching is the intentional activity of the teacher which allows the proposed educational goals to reach the pupils by means of lesson content in

as optimal a way as possible in the context of the teaching-learning situation; this activity concerns planning as well as execution and evaluation of teaching and learning activities and processes.

Insofar as teaching skills are concerned, a sufficiently differentiated elaboration to this concept is only seldom given in the educational literature. It is for this reason as well that clarification of skilled behavior was sought in psychological studies (Lowyck, 1979b).

From the further conceptual analysis, two notions about teaching skills can be discerned - namely, the analytical and the cognitive interpretation.
The first approach is based on the analytical paradigm of Gage (1963) and parallels the development of microteaching (Allen & Ryan, 1969). Teaching skills, then, were determined primarily on the basis of the following characteristics : on the one hand, teaching needs to be unraveled into a number of simple and easily trained "techniques"; on the other hand, there must be a demonstrable relation between discrete teaching behavior and the increase in learning on the part of the pupils (Turney et. al., 1973).

Along with this analytical interpretation which, at the present time, the Anglo-Saxon literature strongly dominates, a broader concept also appears sporadically (Shulman et. al., 1975). The discrete elements of teaching behavior are integrated into a broader concept in which the cognitive processes of the teacher as well as his interaction with the environment will be considered. One is speaking, then, not so much about teaching skills as about skillfulness.

The cognitive description of teaching can, to be sure, offer an interesting point of departure for empirical study, though accurately formulated characteristics seldom come to light in the current literature. It is for this reason that clarification is sought in the psychological research on skillfulness.

In opposition to educational sciences where the study of skills is primarily directed toward analytical interpretation, psychology focuses more attention on the integration of the behavioral elements and on the underlying mental processes. The development of complicated war machinery and the need for the accelerated training of service personnel have greatly influenced the study of skillfulness to proceed in this direction (Bartlett, 1964; Welford, 1968, 1976; and Whiting, 1975). Skillfulness contains, therefore, a number of properties which clearly distinguish it from elementary behavioral elements : complexity, intentionality, organization, coordination, and the state of being learned. These characteristics are further complemented with data which come to the fore

by virtue of the process description of the cognitive models. This point is treated below.

1.2. Cognitive models of teaching and skillfulness

Only static characteristics come to light from the analysis of the precise definitions. It is, therefore, necessary to research the process variables in teaching and skillfulness further as well.

The literature about teaching deals frequently with models. It usually concerns, then, a simplified, schematic reproduction of a more or less restricted number of variables which are deemed important. Because practically no theories of teaching have been developed, the models function as a pretheoretical, conceptual framework which inspiringly infiltrates the research and which can contribute to the development of theories by means of empirical verification.

Within the framework of our study, only the models *of* teaching were considered - namely, those directly concerned with the cognitive functioning of the teacher. In addition, the more numerous models *for* teaching, which mainly concern the variables of teaching strategies for the attainment of learning or interactional goals, may be considered. A clear overview of the last-mentioned models is to be found in the work of Joyce & Weil (1972).

In the psychological literature, there is a considerable number of models to be considered within the cognitive approach the information processing model (Woodruff, 1967, Loftus & Loftus, 1976), the problem solving model (Newell & Simon, 1972 and Landa, 1974), the decision model (Dill, 1964, and the planning-execution model (Miller, Galanter & Pribam, 1960).

Cognitive models of teaching appear more sporadically and isolated in the literature. A possible cause of this is to be found in the emphasis during the last decade placed on researching observable and measurable (interactional) behavior. This is, in turn, to be seen as a reaction against the earlier studies in which teaching was hardly described in its real course.

A detailed exploration into the literature brought a certain number of cognitive models of teaching to light : Coladarci, 1959; Smith, 1960; Ryans, 1963; Stolurow, 1965; Strasser, 1967; Snow, 1970; Gage, 1972; and Shavelson, 1973, 1976. Notwithstanding the significant differences in regard

to the background, the degree of elaboration, and the terminology, a number of important characteristics stand out. Teaching is the activity of the teacher in which his observable teaching behavior is the result of a complex, cognitive processing of external input (environmental variables) as well as of internal input (personal variables). At this same time, attention was paid both to the planning and execution of teaching. The possible influence of the "plan" on the execution comes here consciously under discussion.

A cognitive model is also lacking here with regard to skilled teaching behavior. For this reason, it seems necessary to pursue further the information processing model which was mentioned for the study of skillfulness in psychology, (Bartlett, 1964; Fitts, 1965; Welford, 1968, 1976; and Whiting, 1975). The process characteristics which can be distinguished in skillfulness are the following :

a. The adequate selection of information in light of the task under consideration;
b. The anticipation of coming key features;
c. The processing of information from the short-term memory;
d. The regulation of the tempo;
e. The correction of the behavioral elements during the so-called stationary phase;
f. The adequate execution of ballistic behavior;
g. Expert decision-making; and
h. The efficient use of relevant feedback.

The process variables named are the results of studies which primarily refer to psychomotoric skills as well. From this, inspiration may proceed, to be sure, to research on skilled teaching behavior, though the characteristics cannot simply be transferred. The activities as well as the context in which these are performed are specific. Skilled teaching behavior will, therefore, need to be researched from the specificity of this behavior and from the context - namely, in the teaching-learning situation.

1.3. Research on teaching and on teaching skills

Proceeding from the data worked out in the previous points, it now needs to be further considered whether and to what extent the cognitive models are brought under discussion in the empirical research. Specific attention will be paid as well to the diverse methods which can be employed in such research.

According to Gage (1976, p. 2), the purpose of the research on teaching consists of "the search for relationships between variables where at least one of the variables is a behavior or a characteristic of teachers". The emphasis on distinguishing the relations among variables leads to a well-defined, methodical approach. One is mainly dependent on correlational, experimental, and quantitative-descriptive methods. This approach primarily comes to be expressed in the diverse overviews of classes of variables which come into consideration in the research on teaching - for example, in Mitzel (cited in Gage, 1963, p. 119), Biddle (1964, p. 7), Biddle & Adams (1967, p. 100 ff.), and Dunkin & Biddle (1974, p. 38). It is noteworthy here that a number of variables cannot be placed - the internal, cognitive processes of the teacher and of the pupils, the planning behavior of the teacher, and the effect of the teaching process on the teacher.

In Figure 1 an overview of the classes of variables for research is offered where the hiatuses named are filled in along with some others. Although the listing of the various categories is not exhaustive, an attempt was certainly made to include the most important.

Insert Figure I here

The study of the literature was primarily concerned with the cognitive variables which come forth during the planning and execution of teaching. In the discussion of the research on teaching skills, the performance behavior of the teacher as a process variable and the results produced by the pupils as a product variable come under consideration at the same time.

From the preceding, it also seems that no research strategy exists which is inclined to the studying of cognitive processes during the pre-interactive and interactive phase of teaching. A number of isolated research activities are, of course, known in which certain cognitive variables in the teacher are treated. The concentration in these studies has primarily been on descriptional methods such as the ethnographic methods which include symbolic interactionism, participation and systematic interview, educational connoisseurship and criticism, as well as quantitative and qualitative process analysis.

Ethnographic methods (Wilson, 1977) investigate phenomena in their natural context, mostly from the standpoint of participating observation. In this way, one attempts to understand the situating of the object of study in its complex environment as well as the interpretation which it has been attributed by the

subjects. Therefore, these methods are qualified as qualitative, phenomenological, and anthropological. Indicative of such a method of research is the study of Smith & Geoffrey (1968),who conducted intensive research in a single class in a suburban school. As a variant on the ethnographic methods, they use the inside-outside procedure : the participant as well as the researcher are both completely involved in the research.

Symbolic interactionism has also been named within the interpretative framework of ethnographic studies (Hamilton & Delamont, 1974; Delamont, 1976; and Delamont & Hamilton, 1976). The basic conception was borrowed from Mead. The notion of symbolic interactionism refers to the fact that man, during the interaction, constantly interprets his own behavior and that of others, reacts, reinterprets, and so on. This behavior stands in sharp contrast to non-symbolic interaction - that is, behavior based on reflexes; no interpretation takes place.

Another method equally well directed to understanding a number of cognitive variables is participation and systematic interview (Jackson, 1968). This author constructed an interview only after a long period of observation in the school classes. From questioning fifty teachers from various types of schools and levels, insight into important cognitive variables was obtained. The interview was directed not so much to concrete teaching as to the broader aspects of the teachers' tasks such as the interaction pattern, the use of lesson plans, the attitude toward institutional authority, etc.

A method was proposed by Eisner (1975; 1979) which was branded by him as educational connoisseurship and criticism. With this, the author offers a complementary approach to the current scientific methods in order to base them mainly on an artistic paradigm. It begins from a critical reflection on the employable methods in the domain of the evaluation of teaching. Because the statistical and psychometric techniques entail a serious reduction of the phenomena studied, they do not lead to the clarification of the complexity of the teaching-learning situations and processes. Through his supplementing methods, Eisner wishes to work on the intruding description of educational settings. The knower is prepared to understand the phenomena studied in their historical and sociocultural context through qualitative appreciation. Attention is paid to the hidden, subtile, or suppressed properties which are then uncovered in the criticism.

The above mentioned methods are intended to describe the complex environment in which the teacher functions as well as the cognitive processes which bear influence on a broader task behavior. In addition, quantitative as well as quali-

tative process descriptions are available in which concentration is placed on the cognitive variables during the planning and execution of the teaching itself.

In the quantitative process analysis, use is made of statistical techniques. Examples of this are to be found in Shulman & Elstein (1975), Snow (1968), Shavelson, Cadwell, & Idzu (1977) and others. The prosecution of these techniques requires, however, a strong reduction in the number of variables to be investigated as well as in the research situation. There is little importance attached to ecological validity to the benefit of the incontamination of the measurements.

To this write, only one study on the qualitative process analysis of teaching behavior is known - that of Peterson, Marx, & Clark (1978) from which a partial report was published earlier (Clark & Peterson, 1976). In this case, use was made of the thinking aloud which took place during planning, while the cognitive variables from the interactive phase were retrieved by means of stimulated recall. Although a qualitative process analysis offers, in principle, the opportunity to describe the relevant variables in their truly natural context, the authors have somehow reduced them in the research situation.

From the condensed inventory of methods for the description of cognitive variables in teaching presented above, there seems, therefore, a serious isolation in the various methods of research. With regard to research into teaching skills, there is not a single report directed to *skilled teaching behavior*. An attempt has been made, of course, to discover certain types of teaching behavior which have some effect on the pupils. This is connected to a long research tradition of teacher effectiveness studies (Rosenshine & Furst, 1971; Gage, 1972; and Dunkin & Biddle, 1974). The results of this type of research point, to be sure, in the direction of strong teaching behavior, though the validity of this determination may be doubted. The manner in which the researchers came to their results as well as the technique which was applied for the comparison of the various investigatory results in the meta-analysis do not lend themselves to the drawing of unanimous conclusions (Potter, 1973; Heath & Nielson, 1974; Dunkin 1976; and Glass, 1976).

The reported state of affairs with respect to the description and investigation of the cognitive variables in teaching and teaching skills suggests the devising of a descriptive-empirical project which more deeply penetrates into the analysis of the cognitive factors and processes which come into consideration in the planning and execution of teaching. The results thereof can include suggestions for further research into skilled teaching behavior.

2. Data from the descriptive-empirical research

From the analysis of the literature which concerns research on teaching, it seems not only that the cognitive variables seldom come forth but also, at the same time, that almost no empirical research in this direction has been pursued. Teaching has been approached mostly from an *a priori* reduction which is imposed by the researcher. How the teacher himself functions with respect to the complexity and the intentionality of teaching remains out of consideration.

Based on these considerations, a descriptive-empirical research project has been constructed on the cognitive variables which occur during the pre-interactive and interactive phase of teaching. It is not so much the intention to offer an alternative to current research as to ascribe to it a complementary value. Therefore, the frequently cited dichotomy between external and internal behavior or between a holistic versus an analytical approach was, in essence, dismissed. Teaching cannot be totally understood in its complexity and intentionality through a description of observable behavior; the same teaching behavior is always susceptible to varying intepretations in keeping with the specific context or purpose. On the other hand, teaching cannot be understood merely on the basis of intentionality; intentions must be realized in concrete teaching behavior. Research into cognitive variables is, therefore, to be onderstood in the first instance as the exploration of the process side of teaching which has remained the permanently shadowed side in the studies of the phenomenon until the present time.

Research is, according to Gage (1972), dependent on a content oriented, methodological, and logistic paradigm. Although an attempt here is made, in principle, to place the content-oriented paradigm - that is, the cognitive variables in teaching - in a central position, a certain reduction is always present due to continuous interaction with the method of research as well as with the possibilities and limits of the infrastructure. For this reason, the following restrictions are present in this research.

In the first place, teaching is not investigated as an evolutive process in the long run, though the research has been restricted to a cross section. Furthermore, the size of the random sample as well as the number of events are strongly limited. Finally, the teaching process is studied using only one method - retrospection. Further research will have to drive toward the gradual elimination of this initial reduction by purifying and supplementing the object as well as the method of the research in a critical way.

2.1. Preparation of the research

In connection with the above-mentioned research framework, there were a number of preparatory measures taken. Careful attention has more specifically been paid to the selection and recruiting of the sample and to the choice of topics of the lessons to be adapted.

2.1.1. Selection and recruiting of the sample

Because the research planned was extremely labor intensive, the sample was restricted to sixteen teachers. This number approaches, however, the average that occurs in descriptive studies (Dunkin & Biddle, 1974). Moreover, the sample is comprised of *good* teachers - that is, those able to reflect about their teaching and to word these data adequately. This selection was intended to trace a number of process characteristics of skilled teaching behavior. Further analysis of the real criteria which were employed in the selection of the teachers by the inspectors brought such a large divergence to light that only about *experienced* teachers can be spoken in the further context of this investigation.

The teachers all give instruction in elementary education. In this situation, the teacher has sufficient autonomy in the area of content as well as in the organization of his lessons. At the same time, there is the advantage that inspectors can be called upon to help in the selection; they know the teachers by virtue of their supervisory capacities from repeated classroom visits. The sample was restricted, moreover, to teachers from the fifth grade. By this time, on the one hand, there has been a complete curricular differentiation through which a chance is provided to obtain different lesson topics. On the other hand, there are fewer demands on the performance of teachers and pupils than in the sixth grade where preparation for secondary education permit less opportunity for research.

From the thirty two teachers who were described as good by the inspectors, a definitive sample was finally selected. The heads of the schools concerned were asked for cooperation by telephone and in writing. Thereafter, the teachers were contacted individually by the researcher requesting their cooperating in making a video documentary about teaching in the fifth year. This material would serve in training students in educational sciences. The students, however, would not need to observe only external behavior but also gain access to the more hidden aspects of teaching - those which occur during the planning and execution.

Within this homogeneity it will be attempted to obtain as large a heterogeneity as possible. In the first instance, it is always of importance to explore the diversity in the cognitive processes which would remain comparable on a number of points. The heterogeneity will be noted as follows. The sample consisted of equally as many men as women. They were, moreover, recruited from four different school districts. At the same time, the attempt was made to maintain a balanced distribution with regard to teaching experience, familiarity with the fifth school year, age, the nature and scope of the school as well as the size and composition of the classes.

2.1.2. Choice of the lesson topics

Because the research is first of an exploratory character, an attempt was made to maintain a connection with real class activities. In this perspective, lesson topics were sought which could be perceived as meaningful as to content as well as to organization by both teachers and pupils. To guarantee a certain comparability in the material, each teacher was given the same task as well - the planning and execution of two lessons. Because the nature of the topic can have considerable influence on cognitive processes, two lessons were chosen which were significantly different from each other : one is arithmetic and a second in geography.

Because the video recording of the two lessons conducted by each of the sixteen teachers required a definite time span, it is practically impossible to extract the concrete lesson topics from the operative curriculum. Therefore, after an analysis of the existing curricula and in collaboration with the inspectors, topics were sought that were closely tied to the actual program on the one hand but which could be presented in a time span of approximately one month on the other. At the end, the following topics were chosen : "We paint our classroom," for arithmetic and "The consequences of the long dry spell on the price of a noon meal", as an actual theme from geography, relating to the long, dry summer of 1976 in Belgium.

2.2. Conducting of the research

2.2.1. Lesson preparation

Each teacher was asked to write down the preparation of both lessons as clearly as possible. At this time, the why of the various forms of preparation behavior should have been explicated. To keep the exploration as open as possible, no preperation schemes or other restrictions were imposed in advance. These lesson plans were submitted before the recording sessions.

2.2.2. The recording of the lessons

In the period between October 26 and November 26, 1976, the teachers taught sixteen lessons in arithmetic and as many in geography under experimental conditions. The researcher himself operated a camera with zoomlens mounted on a rolling stand for the video recording. The sound was recorded by means of four microphones while the teacher wore a microphone around his neck. Because the camera can register only a specific part of reality, a number of rules of thumb, followed as conscientiously as possible, were formulated in advance. Because the video material should serve as a basis for retrospection by the teacher, the confrontation with himself should reflect, as honest as possible the real lesson. Afterwards, all the lessons were transcribed and supplemented with a number of nonverbal data. These protocols, then, were utilized as material for analysis.

After each lesson, the pupils were given a short and simple questionaire. The purpose of this was to obtain a bit of insight into their perception of possible reality distortions during the recording situation concerning the video, the lesson topic, the teaching behavior, and their own experiences. The teacher was asked to do the same but only after both lessons had been presented. Due to unusual circumstances, one class was not able to participate. This information was partially obtained at a later date during the retrospection about the lessons.

2.2.3. The retrospection session

A period for reflection was arranged with each teacher concerning the recorded lessons, as soon as possible after the execution of the lesson. This took place during free time such as in the evening, at Wednesday noon, and on Saturday. The average duration of a discussion lasted four hours, with a minimum of three and one half hours and a maximum of five. Because the video tapes were viewed in their entirety, the duration of the session was dependent on the actual recording time, the loquaciousness of the teacher, and his task orientation. The discussion followed a fixed order. After an introductory conversation concerning purpose and working method of the retrospection, reflections were first given concerning the planning of the lesson. Thereafter, the aritmetic lesson and the geography lesson were viewed on the video tape, in that order. The teacher then furnished as many background data as possible concerning his concrete teaching behavior. He could indicate to which forms of behavior retrospection would be relevant. It was expected from this modus operandi that the teacher would discuss the forms of behavior which were most important for him so that an idea about the most critical points in his cognitive functioning could be obtained. Neither a

predetermined unit of analysis nor fixed elements of retrospection were stated before. The researcher could, however, pose a number of questions from his point of view. The purpose of these would again be to ensure the comparability for various aspects of the teaching. Therefore, each teacher was asked about the cognitive variables present in calling on students, organizing and leading group work, his field of perception, and his opinion on the realistic value of the recording sessions.

The teacher's commentary was recorded on tape along with a sound segment from the video tape so that, thereafter, the retrospection could be related to a specific teaching behavior. This recording was later transcribed. This formed, then the material for the analysis of the retrospection data.

2.2.4. Analysis of the material

From the beginning, mention should be made of the researcher's familiarity with the video material. Because he directed the recording himself, prepared the discussions from the viewing of the video tapes, reviewed the tapes once again together with the teacher, and afterwards checked the written protocols as to their completeness as well as to supplementing them with non-verbal data, the lesson protocols were of a sufficiently realistic character.

The researcher first had at this disposal the written lesson plans to be used for analysis. They were analyzed meticulously as to their content. Because the structure and the content were left open, however, the quality of the various plans differed considerably. At this time, few teachers explained the "why" of their concrete planning behavior, and this was later uncovered during retrospection. The disadvantage of this is, however, that the teachers reflect on their preparation after the lesson has been presented. That some confusion at times occurs here is evident from the analysis of the data.

Lesson protocols and the results of retrospection were also accessible for further analysis. The retrospection material was obtained through the use of different types of reflection : concrete, broad, and video retrospection.
The form of retrospection cited first means that the teacher reflects on concrete teaching behavior taken from the research situation which, however, was not recorded on video tape - for example, lesson preparation. Broad retrospection is not so greatly concerned with the concrete teaching as with broader aspects of teaching such as the manner in which the teacher normally prepares lessons, calls on pupils, etc.
Video retrospection, finally, takes place on the basis of the perception of specific teaching behaviors from the recorded lessons which are on video tape.

The problem of analysis is concentrated around the possibility to make use of the material in such a way that the redundant information will be filtered in order to reach a certain degree of abstraction on the basis of which clear description will be possible. In order to come to categories which would cover the material in totality, a recurrent, cyclical analysis has been undertaken.
After the construction of provisional categories, each protocol was once again investigated in search of possible hiatuses. The definite categories thus obtained were further utilized as classes for the reproduction of the results.

Another important problem consisted of the possibility that the teacher during retrospection would lean on assertions about his cognitive functioning which would not be tested as to their reliability. Therefore, use was also made of an external control. The researcher confronted some statements from the retrospection with concrete teaching behavior. At the same time, primarily concentrating on the comparison between planning and execution, the previously written lesson plans were confronted with the transcribed lesson protocols.

2.3. Results

Before going into the more substantial results, account can be given of the perception of the realistic value of the research situation. In general, it can be proposed that a consciousness of a modified situation appears in the pupils as well as in the teachers. Everyone knew that the lessons were recorded. One third of the pupils thought that the teacher reacted differently from his normal behavior - primarily in the quality of relationships. All the pupils felt occasionally watched by the camera, although they told that this had no disturbing influence. The level of more or less difficult and more or less interesting with respect to the lesson content was also investigated. The testing here could not be conducted in such a way as the sign test, because too few changes were reported. Therefore, a bit of support was sought in the percentages. Although the vast majority of the pupils indicated no differences, there were perceptions of change in regard to the lesson topic and/or the teacher. Considering the level of difficulty, it seems that there may be perceived in two directions. Whereas one partially tended to consider arithmetic more difficult the geography, the opposite occured in other classes. The measure of interest was also ambiguously interpreted by the restricted number of student who perceived any change of all.

As for the teachers, there was primarily an indication of a greater investment of time for preparation. The nature of the lesson topics played here an important role for the reason that they were not to be found directly in the curriculum. The disturbance factor of the recording itself was experienced clearly by only one teacher. The others found it slightly disturbing or not al all. Paralleling

the pupils, the teachers had the feeling that they were being watched only occasionally. Whether they behaved "differently" was answered affirmatively, though their explanations about being different consisted of rather detailed data such as not choosing the topic themselves, being more strictly tied to preparation, and the restricted freedom of movement due to wearing the microphone. It appears in every respect that these teachers presented their lessons with a higher degree of consciousness - using more solid planning, building in greater certainty, formulating the structure more clearly, and at times taking explicit account of the supposed wishes of the researcher or of the university students.

The importance of the investigation of the realistic value of the research situation lies primarily in the concern about interpreting the results obtained as a function of the actual cognitive processes which arise. This evaluation of the "ecological" value of the situation is seldom pursued in descriptive research. When any research situation disturbs the normal situation somewhat, it is important, meanwhile, to understand the deviations with respect to the daily situation with the intention of integrating these into the results and the interpretation.

2.3.1. Cognitive variables during planning

For the analysis of the cognitive variables during preparation, support was sought from the following sources : the written lesson plans of the teacher, the concrete retrospection on the preparation, and the broad retrospection on the usual manner of preparation.

2.3.1.1. A process description of the planning of lessons

A precise analysis of the material available from the written lesson plans and the concrete retrospection permits the division of the planning process into the following phases : the inspection of the assignment (title and commentary), the acquisition of the content by the teacher, the determination of the lesson content for the pupils, and the concrete organization of the lesson. Each step in the aforementioned process can be experienced by the teacher either as a task or as a problem. A task contains no problematic character for the teacher so that a routine form of behavior or an automatism can be employed. The performance can, however, contain a problem either wholly or in part : for the solution to these, the teacher needs to appeal to a number of more or less well thought out investigation processes. The results for both lessons will now be reproduced per phase.

Phase I : The inspection of the assignment (title and commentary)

From the results of the concrete retrospection it seems that each teacher has analyzed the title in some way or other. Starting from the assignment, an attempt is made to proceed in orienting the process which follows. All reflect over the assignment in terms of its meaning for themselves, consideration about the meaning for the pupils come at a later stage.

In the arithmetic lesson, the assignment generally was viewed as a task having a non-problematic character. The assignment only becomes problematic when the teacher whishes to include the aspect paint in the lesson. One teacher experiences a problem by seeking for the possible expectations of the researcher to an exaggerated degree : he thinks, namely, that the must interpolate group work within the framework of modern mathematics.

The topic in geography caused problems for all the teachers. They have no experiences with this specific theme while support for the interpretation of the title as well cannot be found in text books or lesson plans. Before interpreting the title, the teacher first seeks information. He makes himself uncritically dependent on the quantum and the content of the information obtained from diverse sources - for example, the pretask assignments of pupils, conversations with shopkeepers, painters, colleagues, and others.

The data above call up the tension between subjective problematic experience and the objective problem field. It seemed, namely, that teachers met with no problem at all so that they interpreted the topic given routinely; they made no precise analysis of the three elements of the title: we, paint, and our class. They directed themselves primarily to the computational aspects and allowed the problems with respect to the painting or to whom this task should be given to be put aside. Concepts such as task and problem are, therefore, not only to be approached via a pole of experience, but they need to be situated in a more objective field.

At the end of this first phase, the teacher seems to have assembled sufficient data to formulate a number of objectives. In opposition to the systems-analytical, instructional models which are, for the most part, logically constructed, it occurs here that objectives are only formulated after there is a certain clarity on the interpretation of the assignment proposed.

Phase 2 : The acquisition of the content by the teacher

After the teacher has interpreted the title, by means of which he can direct himself to the problem side as well as to the task side of the assignment, he searches for contents which are somewhat consistent with the pinpointing of the topic in Phase 1. Where there are problems, the instructor goes to look for content. With a task as well as a problem, the teacher reflects consciously and proceeds from the question, "What must I know to fill the interpreted title?" This question subdivides into two subquestions : "What do I know already"; and "What must I still look up ?" Should there be insufficient information under the second of these subquestions, there exists a problem that must be solved. In this case, the teachers call again on informants and supplement the content, proceeding from the information already obtained. Here it is also the case that little critical distance is taken in the presence of the information already received. The problem is apparently solved when a sufficient quantum of information has been assembled and there remains a certain consistency with the interpretation of the assignment.

Phase 3 : The determination of the content for the pupils

In this phase, the teacher transforms the content gathered himself into lesson content. According to the theme, account must be taken of the beginning level of the pupils in the transposition. In the case of arithmetic, the following aspects of the beginning level were extracted in the reflection : the level of knowledge of the whole class and, at times, of individual pupils or a certain subgroup; the setting in the curriculum; and previous knowledge in relation to certain subaspects of the title, primarily concerning what painting means.

A different process can be discerned in the geography lesson. In the transposition of the content from the teacher to the pupils, no explicit attention was paid to the beginning level. This last determination can be interpreted as follows : as the teacher himself experiences more difficulty in supplementing the content, less importance is attached to its translation to the pupils. In this interpretation, however, account needs to be taken of the following data. First, it is not possible to recover from the retrospection protocols whether the teacher has not already taken account of the content for the pupils during the determination of the content for himself (phase 2). At the same time, it can be alleged that this concerns a theme of actuality. Considerations such as "All the pupils have gone through this dry summer and can, therefore, discuss it," give less occasion for an explicit transposition. Moreover, most of the teachers had given preparatory assignments for geography because of which the pupils were thought to possess sufficient information to be able to follow the lesson. Finally, the topic fell outside of the

existing curriculum : the teacher could not lean on experiences from previous years to appraise the beginning level of his pupils.
At the end of the phase, namely when the content is determined for the pupils, most teachers are able to formulate more operationalized objectives.

Phase 4 : The organization of the lesson

The content which has been selected and refined in the preceding phase is then integrated into a lesson plan in a concrete way. The organization is restricted to the following points :

a) The ordering of the lesson content in which logical as well as psychological ordering principles are applied;
b) The assignment of pretasks with a dual purpose - the continuing orientation of the pupil with respect to the lesson content as well as inspiring motivation for the theme and pursuing social goals such as by the interview;
c) The choice of methods - classroom teaching, individual work, or groupwork, all following certain considerations.

Classroom teaching was chosen primarily to provide each pupil with identical information in order to guide the thinking of all the pupils in a set direction or in order to offer the results of individual or group work to the entire class. Groupwork was chosen on the basis of the following arguments : the university encourages groupwork; the topic is so complex that it must be divided into smaller units; time must be budgeted, and the pupils must learn to work with each other. The composition of the groups also forms part of the conscious consideration by which advantages or disadvantages are weighed against each other. More specific is the question whether weak and strong students should be placed next to each other or heterogeneous groups must be formed on other bases such as interest or personal group choice. Individual work was set up primarily to accomodate the needs of particular pupils, although organizational considerations such as the avoidance of disturbing behavior or contential mistakes also play a role.

d) The media were chosen by most of the teachers in one form or another though there was seldom any basis given for the choice during retrospection :

They think it obvious that cards, for example, are used in the geography lesson. They sometimes take support during reflection from rather vague decision arguments or pedagogical-didactic principles such as motivation and clarity, raising interest in the pupils et alia.

e) Distribution of time was named explicitly by only two teachers as a conscious component of preparation, although it seemed later that teachers allot time frames mostly on the basis of their concrete experiences with their pupils and with the topic or the area of study.

f) Application and evaluation were mainly seen as a control on the undertanding of the content.

This phasing process is reproduced in the form of a flow chart in Figure 2. The diverse cognitive processes are treated therein.

Insert Figure II here

2.3.1.2. The style of preparation

In order to understand the teacher's cognitive functioning during the planning of his lessons over a broader time span, information was gathered by means of broad retrospection. From the material, two processes came to the fore as being important - the gradual condensation of the lesson content and the cumulative integration of pupil reactions. Moreover, one sometimes draws attention to the manner in which information is stored or in which anticipatory behavior appears.

Concerning the gradual condensation of lesson content, the teachers follow a specific pattern. With new lesson content, either at the beginning of the job or on introducing new material, planning was exceedingly detailed. Information was sought for this purpose in the sources available - the curriculum, the textbooks and manuals, documentation, and personal contacts. This planning activity comprises a conscientiousness stemming from a need for certainty : "You do not yet see the problems yourself." After the passing of some time, a more systematic working approach exists : only the main points are still explicated and written down eventually in the class agenda. They form, as it were, the cristalization of a broader background. This condensation seems to have a dual effect. Some teachers see the opportunity for greater flexibility. These data correspond closely to what Miller, Galanter, and Pribram (1960) define as a plan : "... rough, sketchy, flexible anticipations in the course of behavior". Others on the contrary tie themselves uncompromisingly to their preparation.

Van Parreren (1978) speaks of the gradual reduction in the number of control points. It remains problematic, however, whether the reduction of the contential data is directed toward adequate points. It is, namely, not hypothetical, that a formal condensation appears but that this reduction is neither optimal nor desirable. The criteria used for the reduction can, however, not be determined merely on the basis of description.

Another important process consists of the cumulative integration of pupil reactions. Teachers frequently incorporate previous experiences with pupils, classes, or individuals into concrete lesson plans. For the most part unexpectedly, striking negative or positive reactions rise out from the memory. This cumulative experience gives them a feeling of security which is totally lacking in the beginning of the job, because "You do not know which problems the children have because you do not yet see the problems youself." Here, there is also a certain ambiguity. Some teachers fixed on previous experiences : "You pick up experiences; you try to put a thread in your lesson in the direction of former years." If the teacher primarily anticipates on the basis of these experiences, his teaching receives a strongly guided character. On the other hand, this accumulation of experiences can provide flexibility : "You think about the striking data and try to do it otherwise."

This broad retrospection does not place us in a position, however, to explore the complex processes which provide guidance to integration and condensation intricately. For this, further research will be necessary.

2.3.2. Cognitive variables during the interactive phase

In order to find out the cognitive variables during execution use was made of video retrospection. In addition, for certain facets of interactive behavior, broad retrospection was also employed. Processing the results, however, did cause one difficulty here. Contrary to the planning, which was analyzed on the basis of the written protocols and of concrete retrospection, the video retrospection was more directed to discrete moments occuring during execution. The teacher as well as the researcher contributed points for reflection. This method of working, however, implies that the concrete flow of the lesson was continually interrupted. For this reason, another classification scheme had to be applied. A further point of difference between the analysis of the planning and of the execution lies in the difficulty to impose a clear distinction in this last mentioned phase between the two lesson topics and situations. Because the arithmetic lesson was treated first, the teacher often had the feeling during the retrospection period covering the geography lesson that most important matters had already been discussed. The fading of the difference, however, is not so important in this context, as it concerns to a great degree the describing of the external and internal input which demand attention just as well as the information processing. In order to clarify certain variables, several illustrations from the protocols were applied.

2.3.2.1. Cognitive processes

Because the quality of the retrospection is dependent on the verbalization as well as on the unit of analysis in question, an optimal process description could not always be obtained. The practice of placing as little pressure as possible on the teacher resulted in relatively few precisely defined descriptions. The following main processes could be retrieved from the data : perception, interpretation, the storage of information, decisions, and anticipation. These processes, however, need to be seen in relation to the internal as well as the external input (subsections 2.3.2.2. and 2.3.2.3.), through which the content of the processes is made clear. The concern here is the reproduction of the processes defined by the teachers themselves.

With respect to perception, it has been determined that it is clearly dependent on situational data. Perception also comprises other qualities and functions in various situations. For this reason, perception during classroom teaching is either simultaneous, meaning that the class is perceived in a glance, or successive, meaning that the individual pupils are rapidly scanned one after the other. To the extent that the class reacts normally - that is, along the lines of the teacher's expectations - perception is general and unconscious. Should there be, however, unexpected or undesirable reactions from the pupils, attention is then immediately directed to the subject at hand.

A second process which was defined by the teachers in relation to practical teaching behavior is interpretation. This implies that the teacher recognizes a specific significance in the information gathered through perception. Because the teacher himself sets the points of retrospection, this produces few complete results. This open situation offers the advantage, however, that the teacher can reflect more authentically. All teachers interpret the class situation continually on the basis of the characteristics perceived or external input and of their expectations or internal input. One of the most important indicators for interpretation is the extent to which pupils are attentive, meaning active.

The process of storing information was little reported by the teachers. Nevertheless the statements can be broken down into the following categories. First, during planning the lesson structure and content are stored in the memory. Further, during execution, information which is to be recalled in a later phase is also stored : "I said 'localize' explicitly because Jim asked for the meaning at the beginning of the lesson." Consequently, certain information from previous lessons is reactivated : "Think about the Colorado beetle from the last lesson in natural science". Finally, use is made of information stored in past years : "Certain questions

suddenly reemerge in me because pupils in former years had asked them already." In this regard, one can also point to forgetting. Sometimes a teacher intends to actualize information but forgets it later. This usually concerns content or organizational measures which are perceived as less essential for the progress of the lesson. It is noteworthy that more was forgotten in the geography lesson. Perhaps the non-cumulative character and the greater input from the pupils plays a role here.

It is striking that the teachers seldom referred explicitly to decisions which they take during the interactive phase. They accentuate primarily the routine aspect of executing behavior. Only two teachers indicated decisions concerning a perceived crisis situation : "It cut the Gordian knot and chose the certain for the uncertain." Perhaps the sample of experienced teachers plays as much of a role as the method of retrospection. At the same time, the immediacy and the speed of interactive teaching behavior can be causes for the relatively few well-considered decisions. Finally, the most important decisions are taken perhaps already during the planning of the lesson to the end that the execution receives rather routine treatment directed toward "keeping the lesson moving along".

Finally, anticipation was also reported, a point at which the teacher expected explicit, definite answers or forms of behavior from the pupils. As already indicated in connection with planning style, this anticipation can function in two directions : toward a greater openness on the one hand and toward a more closed structure on the other. One can so direct himself toward expected occurances that the actual progress is thereby disrupted. On the other hand, certain problems can already be foreseen in which anticipating measures have already been taken to forestall these problems.

The results of the retrospection concerning information processing make clear that the teachers seldom execute the conscious processes spontaneously. Only the data on perception come forward in a more detailed way because the researcher brought it to bear as a point for retrospection. The initial choice to let the teacher as free as possible in the identification of retrospection points was prompted through a need for the description of real cognitive variables. On the basis of the aforementioned data, however, the point may be argued for research where use is made of shorted lesson fragments which could be discussed in a more directed and detailed way. This presumes from the teacher, however, a certain level of consciousness as well as a definite ability to verbalize. Perhaps these need first to be trained.

2.3.2.2. Internal input during the interactive phase

Among the internal input variables are the following : the background data at the teacher's disposal from which he reacts to a situation. On the basis of retrospection, the following data are extant : expectations, lesson structure, personal characteristics, and pedagogical-didactic principles.

Every teacher reacts from a set of expectations which bear influence on observable behavior. In that regard, two prominent categories require attention : expectations with respect to pupils on the one hand to lesson content on the other. With respect to the pupils, the phenomenon is mostly concerned with pupils' not being able to participate actively in the teaching-learning process. "I had not expected that so many would raise their hands." These expectations also play a role during planning such as in the determination of the entry level. The expectations, though, become more concrete during execution. Contact with the pupils actualizes this. Concerning lesson content, the expectations proceed toward the appearance of specific curricular elements or of particular mistakes. It is anticipated that a well-defined-word, a fact, a sentence, or reasoning by pupils will be introduced. Utterances such as, "I want to hear the word 'output'," or "They must come here to the relation between supply and demand," point to this. The matter mostly concerns, then, data which, at least in the eyes of the teacher, are deemed indispensible for the further progress of the lesson. They expect, moreover, certain mistakes from their pupils on the basis of previous experiences.

The lesson structure which is the result of the pre-interactive phase also forms a well-defined form of input. Teachers are themselves quite conscious, as a rule, of the general lesson structure which is, then, eventually supplemented by virtue of situational data, mainly in the form of pupil reactions. This lesson structure can take on a coercive character, and it forms a space in which the answers or reactions of pupils are not accepted. A considerable number of utterances point in this direction : "I have a few main ideas which I urgently want to reach : the rest can possibly be omitted," or "I have what is important in my head, and I wish that it would come out." There is perhaps a definite connection between the specificity of the expectations influenced by lesson content and the rigidity of the lesson structure conveyed. This problem will be treated below.

Although teachers rather seldom reflect over their own personality traits during retrospection, this point arises in the form of very definite and specific characteristics. Teachers report some properties which they recognize in themselves and which are also, then, expected from the pupils, for example, "I do not want them to lose time : I work extremely fast as well." In this regard, the need is also

obvious for a more directed retrospection process or depth-interview. The need lies however, in discovering possible, cognitive variables in an exploratory way, as far as this study's purpose is concerned.

Finally, a teacher indicated physical circumstances as internal input. The teachers were asked to provide information about their teaching. This instruction directed the teacher's reflection primarily to the variables which are more closely aligned with teaching behavior than with physical circumstances.

2.3.2.3. External input variables

Contrary to the retrieval of the input variables, the teacher has considerably more difficulty in identifying precisely specific categories from the environment which influence teaching behavior. Explicit environmental components come into consideration during planning - namely, the assignment set forth, the content, the pupils, and the organization of the lesson. This external input is then worked into a lesson plan which is converted to internal input by means of storing it in the memory. This probably constitutes the reason for a rather minute reflection capability with respect to external variables during the interactional phase.
In the discussion of the information processing, it has already been indicated that specific environmental variables, among which pupil reactions are to be principally named, are taken into account.
A number of characteristics from the physical environment were also sporadically reported. This reduction of the external input to pupil reactions is, in our opinion, to be framed in the clear difference between planning and execution. From the moment that the teacher comes to a certain form of lesson preparation, the pupils form the most prominent external indicators on which the internal input during the interaction can be tested. Of course, the nature of the retrospection situation also plays a role here. The teachers see themselves and the pupils principally on the screen through their attention and from that their reflection are also directed. Retrospection does not, therefore, seem to be an optimal technique to reveal external input. In this respect, the ethnographic studies are more appropriate.

2.3.3. The relation between planning and execution

In the previous paragraphs, the results of the analysis of planning and executive behavior have been concisely reproduced independently. Although data already determined concerning the relation between the two phases can be derived from this point, it seems desirable to make this relation explicit so that it serves as an object of research. To that end, attention was paid to the recovery of the continuity between

planning and execution by means of the retrospection. Because there are a number of disadvantages connected to the recovery of this relation after the lessons have already been given, however, an external comparison between written plans and lesson protocols was also conducted.

2.3.3.1. Results of retrospection

During retrospection, the continuity and discontinuity between the two phases of teaching was frequently pointed out. The discontinuity is more prominent in the data, however, allowing it to be broken down into more differentiated categories.

In the case of continuity, all the teachers point out that planning was seen as guideline, a mainstay, and a global structure which was followed to a greater or lesser extent during interaction. This rather broad planning was, then, further specified during the execution on the basis of pupil answers as well as on the background experience of the teacher. Concrete behavior was seldom planned but formed a part of the repertory of human behavioral capabilities.

The retrospective process is primarily relevant for indicating the deviations which occur in the presence of the preparation proposed. These indicators can be categorized as follows : content, lesson structure, an estimate of the entry behavior, a consideration of momentary data, an estimate of time requirements, and unexpected data.

The changes in the content were primarily conceived as an addendum, a deviation, or a contraction of the content planned. This occurs mostly out of a need for clarification or because the lesson must occur within the time span foreseen.

In relation to the lesson structure, the differences in rigidity with which the structure prepared is conveyed has already been pointed out above. It was thereby determined that the nature of the subject plays a role in the guiding or unguiding character. In addition, the teacher will push the content which has been found to be less essential to the end of the lesson and deals with them if there is sufficient time.

During the pre-interactive phase, pupils were sometimes over estimated or underestimated. This estimation of the entry situation implies that certain pints in the organization and the content must be brought to bear. In certain cases, the teacher decides to let the pupils have the floor more often, a case in which a certain part of the lesson is less dependent on the content prepared than on the momentary contributions of the pupils. This occurs primarily when the teacher has foreseen considerable margin in his preparation, or, in other words, he has the impression

that there is "too little material" on the subject at hand.

Although few teachers record time distribution explicitly in their lesson plans, it appears from the retrospection that they have an implicit picture of the use of time expected. The impression that the lesson will not be completed forces certain measures to be taken such as calling on bright students, deviding tasks into complementary groupwork, or the assigning of well chosen pupils to give reports.

Finally, a number of unexpected data arise in the classroom situation such as the miscalculation of a surface area by the teacher, the omission of a surface to be painted, both of which among other eventualities require quick reaction.

2.3.3.2. Results of the external analysis

To supplement the retrospective data, an external analysis was conducted in which the written lesson plans were compared to the lesson protocols. In this way it was attempted to get a more detailed picture of the discontinuity as well as sure control over the validity of retrospection.

In the case of content, there appears from this external analysis to be much more precision than reached with retrospection. This arises, from other considerations also, through the teacher's not going into all the points of teaching during retrospection but into a number of discrete moments. In addition, there is less danger of contamination among the remembrances of preparation. Here also, three categories of discontinuity can be retrieved : supplementing, deleting, and pinpointing. Supplementations appear under the form of interim repetitions, tentative syntheses, or conclusions. From this analysis, a much larger quantity of deleted information comes to light. This ranges from small details to larger lesson units such as the discussion of the clay region or the indication of the course of circulation of water. These data agree to a great extent with the results of retrospection though they are here more refined. This is an important determination in connection with the validity of retrospection.

The lesson structure was, with slight exception, closely followed in the arithmetic lesson, though this was not the case in geography. Here also, a more precise picture was obtained in relation to deviations from the structure planned. From the above, it seems that a supplementing of retrospective data via external analysis is desirable. The teacher is not prepared to give a complete overview of the continuity and discontinuity between the two phases of teaching. The results point to a relatively

strong influence of the planning on the execution, especially in relation to content. On the other hand, planning is not always binding on sequence or on the concrete distribution of time. In a comparison between arithmetic and geography, it is noteworthy that, when considering cumulative lesson content, a much stronger binding exists between all facets of planning than in non-cumulative material.

Finally, a lesson plan determines the space in which the interaction progresses. Pupil responses were selected in function of their agreement with the answer expected. This expectation or this plan is used on a flexible way only when the teacher was of the opinion that it concerned less essential factors. What goes on in the mind of the teacher during the planning and execution of teaching seems to be an important determinant of concrete teaching behavior.

Conclusion

In summary, it can be proposed that the descriptive-empirical research under consideration signals a first step in the analysis of the cognitive variables in teaching. This is important as such. Due to a lack of adequate, concrete, elaborated methods, we ourselves needed to construct a project. From the results, it seems that the techniques developed have met the purpose of this study to a definite extent. A further elaboration of the object of the research as well as the methods still seem important. First of all, an explicit complementarity between the cognitive process approach and behavioral description needs to be sought. Further, descriptive research will have to be directed to specific aspects which have arisen in this exploratory study. Projected even further, the evaluation of connections between certain variables can be considered - which, in the last analysis, can provide direction for the systematic manipulation of internal processes or of external behavior. Finally, there will remain a need for the clarification of the tension between theory and practice and between description and prescription. The contribution of our research forms, in this regard, a modest starting point.

Summary

Stemming from the need to systematize the proficiency training of student teachers further through the use of research, the object of research is gradually transferred from the training methods to teaching and teaching skills themselves. To be able to see this in its complexity and intentionality, it seems that merely describing observable teaching practices would be unsatisfactory. In this research, therefore, ample attention has been devoted to the rendering of the internal, cognitive processes which have an influence on the teacher during the planning and execution of lessons (1).

A comprehensive analysis of the literature coming from within the Anglo-Saxon language group has been conducted before conceiving and elaborating the descriptive, empirical research. The result thereof seems to be that, up to the present time, attention has seldom been devoted to the cognitive processes of teaching. From this, it was deemed necessary to define the object of the research as well as the methods to a more concise degree. Following that approach, attention proceeded mainly to the process description of planning behavior, to the cognitive processes which take place during execution, and to the relation existing between these two phases of teaching. In order to realize this description, use has been made of the method of retrospection, which has been devised with several variations, and completed by using lesson protocols.

The research was conducted with a limited number of teachers, sixteen from the fifth grade of elementary education. It is for this reason that the results of the research may be regarded rather as neuristics employed in the understanding of the complexity of teaching. Likewise, a method has been applied in which the possibilities and limitations of understanding cognitive variables could be considered critically. The research at hand, therefore, has been pursued as a first step toward the preparation of further studies.

(1) The terminology used to describe the two phases of teaching, refers to this used by Miller, Galenter and Pribram in their book "Plans and the structure of behavior".

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Curriculum Vitae

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Figure I. Model of teacher and learner variables in the instructional process

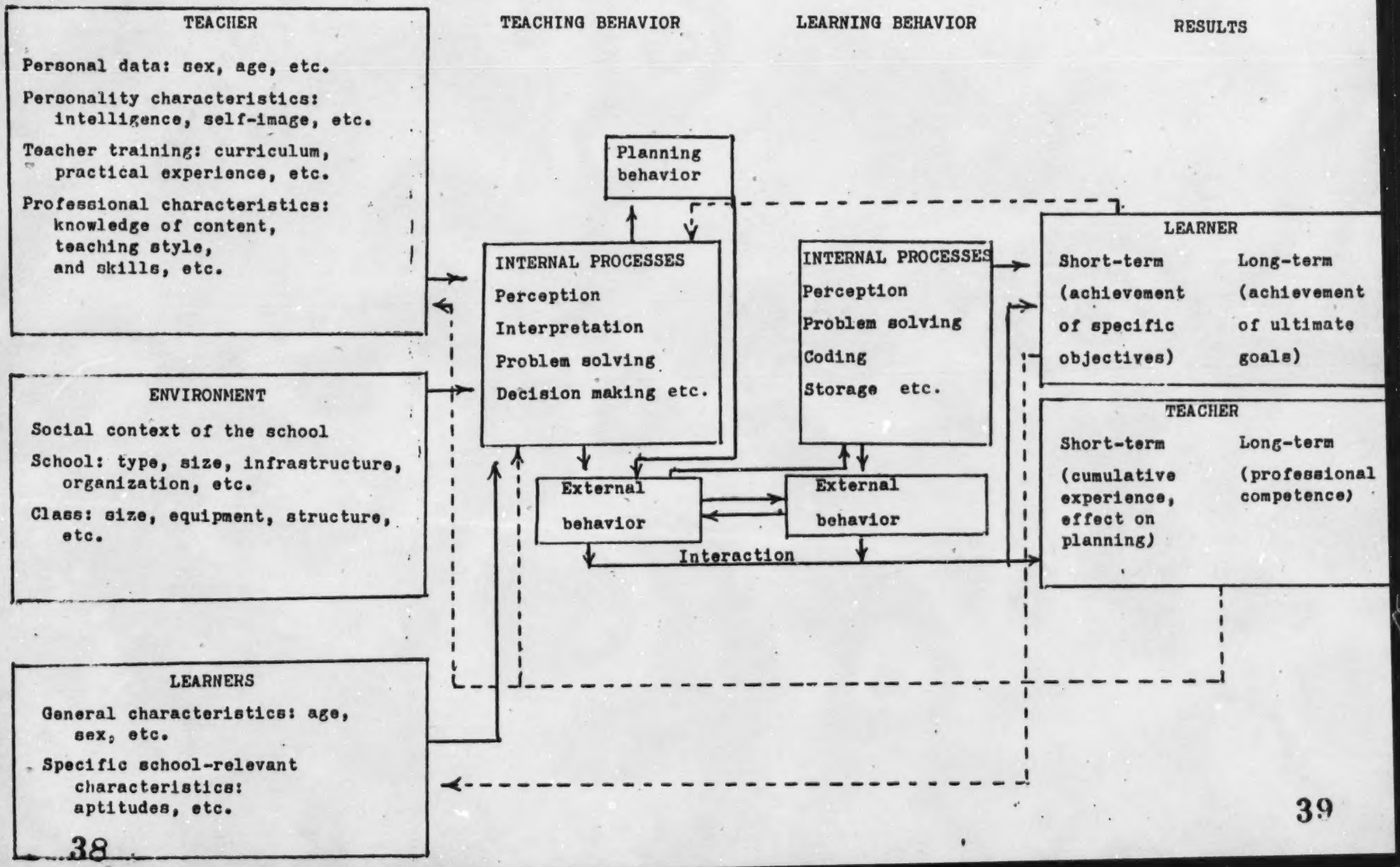

Figure II. Flow diagram of the process analysis of the recorded lesson in arithmetic and geography